

1. *Chlorophyll a* (Chl *a*)
 2. *Chlorophyll b* (Chl *b*)
 3. *Chlorophyll c* (Chl *c*)
 4. *Chlorophyll d* (Chl *d*)
 5. *Chlorophyll e* (Chl *e*)
 6. *Chlorophyll f* (Chl *f*)
 7. *Chlorophyll g* (Chl *g*)
 8. *Chlorophyll h* (Chl *h*)
 9. *Chlorophyll i* (Chl *i*)
 10. *Chlorophyll j* (Chl *j*)
 11. *Chlorophyll k* (Chl *k*)
 12. *Chlorophyll l* (Chl *l*)
 13. *Chlorophyll m* (Chl *m*)
 14. *Chlorophyll n* (Chl *n*)
 15. *Chlorophyll o* (Chl *o*)
 16. *Chlorophyll p* (Chl *p*)
 17. *Chlorophyll q* (Chl *q*)
 18. *Chlorophyll r* (Chl *r*)
 19. *Chlorophyll s* (Chl *s*)
 20. *Chlorophyll t* (Chl *t*)
 21. *Chlorophyll u* (Chl *u*)
 22. *Chlorophyll v* (Chl *v*)
 23. *Chlorophyll w* (Chl *w*)
 24. *Chlorophyll x* (Chl *x*)
 25. *Chlorophyll y* (Chl *y*)
 26. *Chlorophyll z* (Chl *z*)
 27. *Chlorophyll aa* (Chl *aa*)
 28. *Chlorophyll ab* (Chl *ab*)
 29. *Chlorophyll ac* (Chl *ac*)
 30. *Chlorophyll ad* (Chl *ad*)
 31. *Chlorophyll ae* (Chl *ae*)
 32. *Chlorophyll af* (Chl *af*)
 33. *Chlorophyll ag* (Chl *ag*)
 34. *Chlorophyll ah* (Chl *ah*)
 35. *Chlorophyll ai* (Chl *ai*)
 36. *Chlorophyll aj* (Chl *aj*)
 37. *Chlorophyll ak* (Chl *ak*)
 38. *Chlorophyll al* (Chl *al*)
 39. *Chlorophyll am* (Chl *am*)
 40. *Chlorophyll an* (Chl *an*)
 41. *Chlorophyll ao* (Chl *ao*)
 42. *Chlorophyll ap* (Chl *ap*)
 43. *Chlorophyll aq* (Chl *aq*)
 44. *Chlorophyll ar* (Chl *ar*)
 45. *Chlorophyll as* (Chl *as*)
 46. *Chlorophyll at* (Chl *at*)
 47. *Chlorophyll au* (Chl *au*)
 48. *Chlorophyll av* (Chl *av*)
 49. *Chlorophyll aw* (Chl *aw*)
 50. *Chlorophyll ax* (Chl *ax*)
 51. *Chlorophyll ay* (Chl *ay*)
 52. *Chlorophyll az* (Chl *az*)
 53. *Chlorophyll aza* (Chl *aza*)
 54. *Chlorophyll abz* (Chl *abz*)
 55. *Chlorophyll acz* (Chl *acz*)
 56. *Chlorophyll adz* (Chl *adz*)
 57. *Chlorophyll aez* (Chl *aez*)
 58. *Chlorophyll afz* (Chl *afz*)
 59. *Chlorophyll agz* (Chl *agz*)
 60. *Chlorophyll ahz* (Chl *ahz*)
 61. *Chlorophyll aiz* (Chl *aiz*)
 62. *Chlorophyll ajz* (Chl *ajz*)
 63. *Chlorophyll akz* (Chl *akz*)
 64. *Chlorophyll alz* (Chl *alz*)
 65. *Chlorophyll amz* (Chl *amz*)
 66. *Chlorophyll anz* (Chl *anz*)
 67. *Chlorophyll aoz* (Chl *aoz*)
 68. *Chlorophyll apz* (Chl *apz*)
 69. *Chlorophyll aqz* (Chl *aqz*)
 70. *Chlorophyll arz* (Chl *arz*)
 71. *Chlorophyll asz* (Chl *asz*)
 72. *Chlorophyll atz* (Chl *atz*)
 73. *Chlorophyll auz* (Chl *auz*)
 74. *Chlorophyll avz* (Chl *avz*)
 75. *Chlorophyll awz* (Chl *awz*)
 76. *Chlorophyll axz* (Chl *axz*)
 77. *Chlorophyll ayz* (Chl *ayz*)
 78. *Chlorophyll ayz* (Chl *ayz*)
 79. *Chlorophyll azz* (Chl *azz*)
 80. *Chlorophyll azaa* (Chl *aza*)
 81. *Chlorophyll abz* (Chl *abz*)
 82. *Chlorophyll acz* (Chl *acz*)
 83. *Chlorophyll adz* (Chl *adz*)
 84. *Chlorophyll aez* (Chl *aez*)
 85. *Chlorophyll afz* (Chl *afz*)
 86. *Chlorophyll agz* (Chl *agz*)
 87. *Chlorophyll ahz* (Chl *ahz*)
 88. *Chlorophyll aiz* (Chl *aiz*)
 89. *Chlorophyll ajz* (Chl *ajz*)
 90. *Chlorophyll akz* (Chl *akz*)
 91. *Chlorophyll alz* (Chl *alz*)
 92. *Chlorophyll amz* (Chl *amz*)
 93. *Chlorophyll anz* (Chl *anz*)
 94. *Chlorophyll aoz* (Chl *aoz*)
 95. *Chlorophyll apz* (Chl *apz*)
 96. *Chlorophyll aqz* (Chl *aqz*)
 97. *Chlorophyll arz* (Chl *arz*)
 98. *Chlorophyll asz* (Chl *asz*)
 99. *Chlorophyll atz* (Chl *atz*)
 100. *Chlorophyll auz* (Chl *auz*)
 101. *Chlorophyll avz* (Chl *avz*)
 102. *Chlorophyll awz* (Chl *awz*)
 103. *Chlorophyll axz* (Chl *axz*)
 104. *Chlorophyll ayz* (Chl *ayz*)
 105. *Chlorophyll ayz* (Chl *ayz*)
 106. *Chlorophyll ayz* (Chl *ayz*)
 107. *Chlorophyll ayz* (Chl *ayz*)
 108. *Chlorophyll ayz* (Chl *ayz*)
 109. *Chlorophyll ayz* (Chl *ayz*)
 110. *Chlorophyll ayz* (Chl *ayz*)
 111. *Chlorophyll ayz* (Chl *ayz*)
 112. *Chlorophyll ayz* (Chl *ayz*)
 113. *Chlorophyll ayz* (Chl *ayz*)
 114. *Chlorophyll ayz* (Chl *ayz*)
 115. *Chlorophyll ayz* (Chl *ayz*)
 116. *Chlorophyll ayz* (Chl *ayz*)
 117. *Chlorophyll ayz* (Chl *ayz*)
 118. *Chlorophyll ayz* (Chl *ayz*)
 119. *Chlorophyll ayz* (Chl *ayz*)
 120. *Chlorophyll ayz* (Chl *ayz*)
 121. *Chlorophyll ayz* (Chl *ayz*)
 122. *Chlorophyll ayz* (Chl *ayz*)
 123. *Chlorophyll ayz* (Chl *ayz*)
 124. *Chlorophyll ayz* (Chl *ayz*)
 125. *Chlorophyll ayz* (Chl *ayz*)
 126. *Chlorophyll ayz* (Chl *ayz*)
 127. *Chlorophyll ayz* (Chl *ayz*)
 128. *Chlorophyll ayz* (Chl *ayz*)
 129. *Chlorophyll ayz* (Chl *ayz*)
 130. *Chlorophyll ayz* (Chl *ayz*)
 131. *Chlorophyll ayz* (Chl *ayz*)
 132. *Chlorophyll ayz* (Chl *ayz*

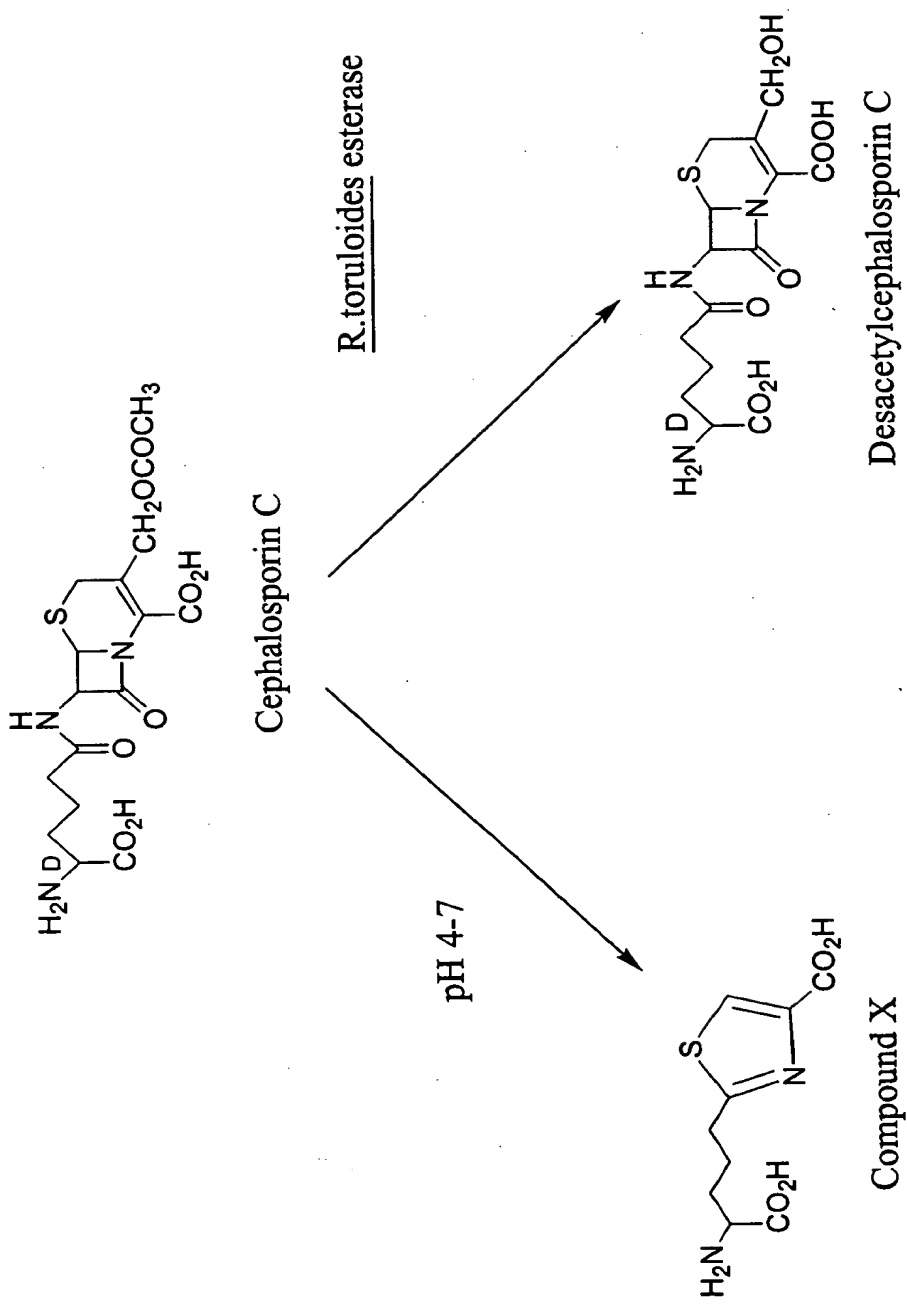


FIG. 1

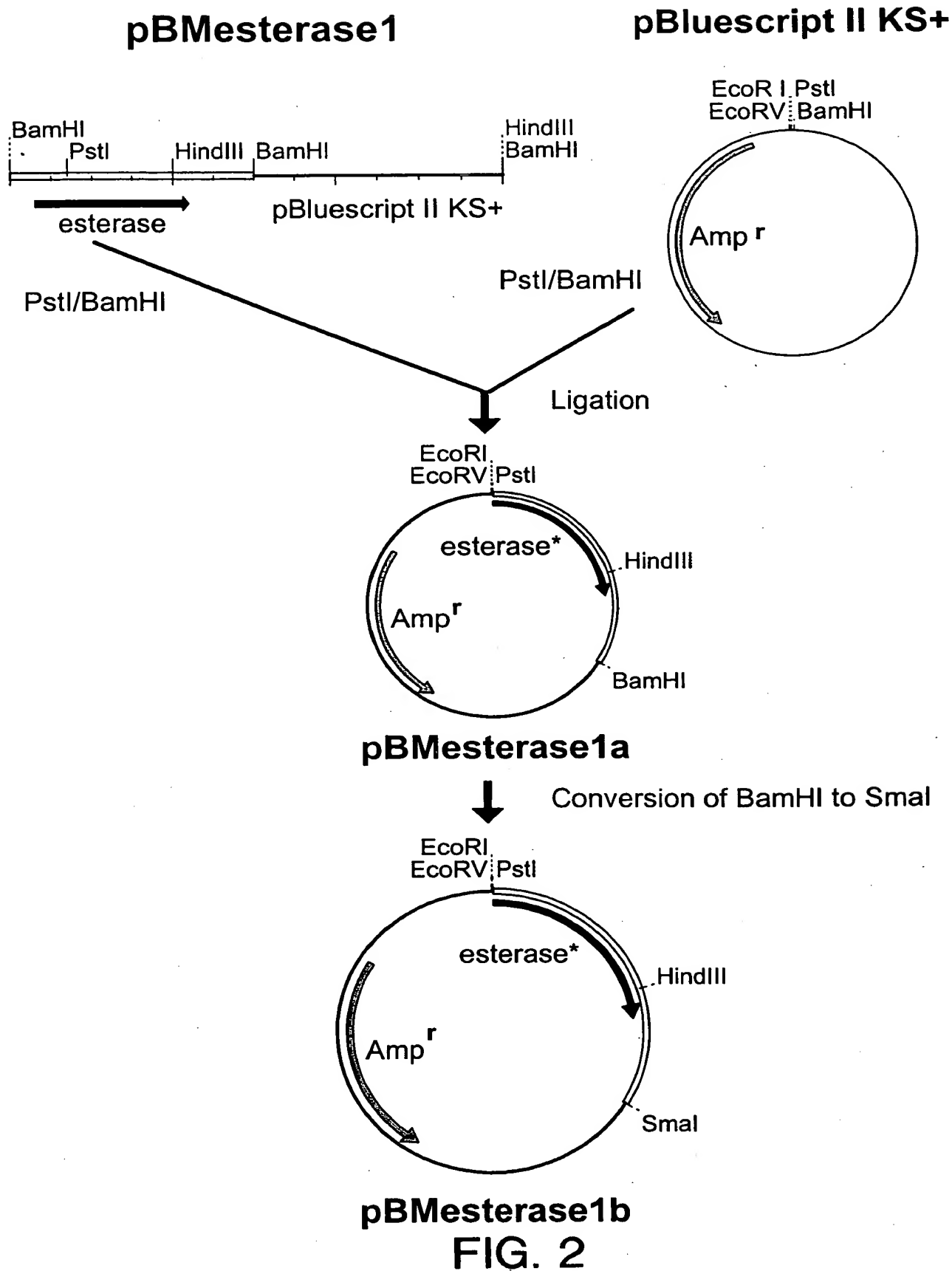
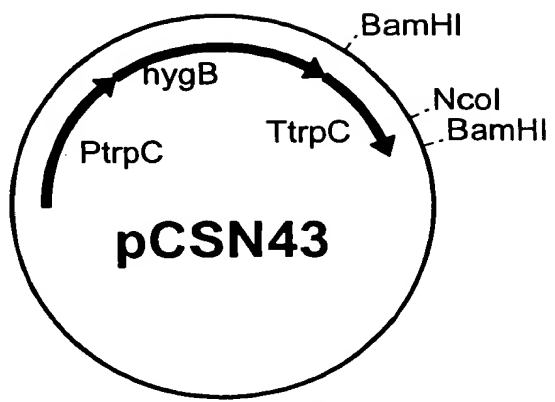


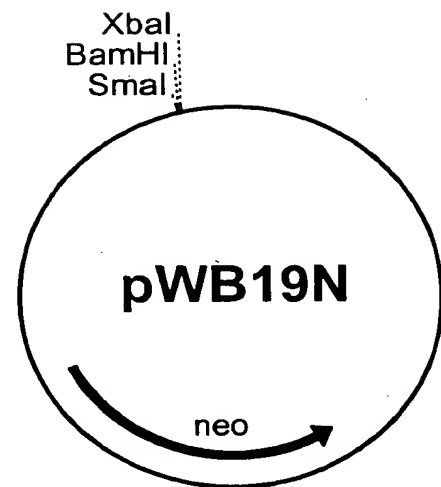
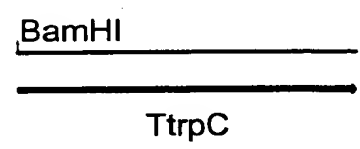


FIG. 3

pSJC62.3
FIG. 4



NcoI cleavage
Klenow
BamHI dgest
591 bp fragment gel purified



XbaI cleavage
Klenow
BamHI Digest
2.9 kb fragment gel purified

Ligation

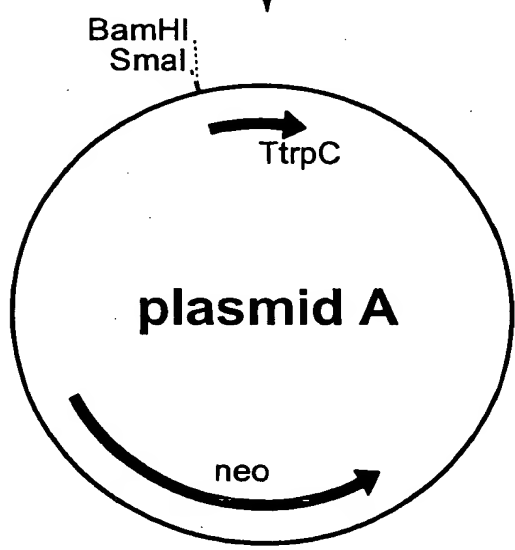


FIG. 5

FIG. 5

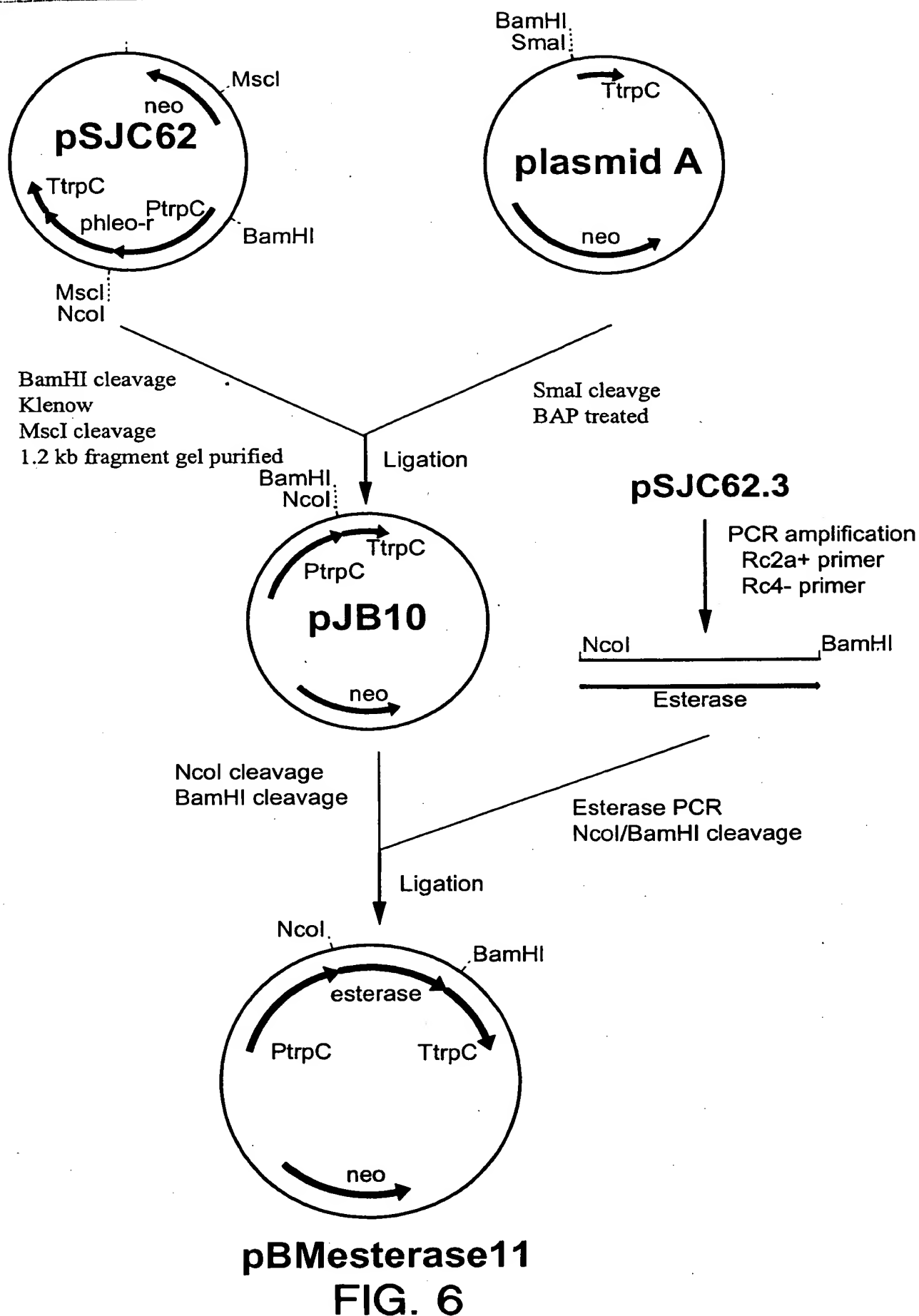


FIG. 6

APPROVED	O.G. FIG.	
BY	CLASS	SUBCLASS
DRAFTSMAN		

N-TERMINAL AMINO ACID SEQUENCE

AMINO ACID SEQ.	T N P N E P																												
REV. TRANSLATION	ACX AAPy CCX AAPy GAPu CC																												
INVERSE	GGPy TCPu TTX GGPu TTX GT																												
PROBE	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">1</td> <td style="width: 15%;">GGPy</td> <td style="width: 15%;">TCPu</td> <td style="width: 15%;">TTG</td> <td style="width: 15%;">GGPu</td> <td style="width: 15%;">TTX</td> <td style="width: 10%;">GT</td> </tr> <tr> <td>2</td> <td></td> <td></td> <td>A</td> <td></td> <td></td> <td></td> </tr> <tr> <td>3</td> <td></td> <td></td> <td>T</td> <td></td> <td></td> <td></td> </tr> <tr> <td>4</td> <td></td> <td></td> <td>C</td> <td></td> <td></td> <td></td> </tr> </table>	1	GGPy	TCPu	TTG	GGPu	TTX	GT	2			A				3			T				4			C			
1	GGPy	TCPu	TTG	GGPu	TTX	GT																							
2			A																										
3			T																										
4			C																										

Four 17-mer oligonucleotide probes each with a 32-fold degeneracy were synthesized from the N-terminal amino acid sequence and used to probe a Southern blot of *R. toruloides* DNA.

FIG. 7

APPROVED	D.G. FIG.	
BY	CLASS	SUBCLASS
DRAFTSMAN		

RHODOSPORIDIUM ESTERASE cDNA

ATGCTCCTTAACCTCTTCACCCTCGCCTCCCTCGCTGCGACGCTCCAGCTCGCCTTTGCC 70
M L L N L F T L A S L A A T L Q L A F A

TCTCCGACCTCCCTCGTCCGCCGCACGAACCCAAACGAGCCCCCTCCCGTCGTCGACCTC 130
S P T S L V R R T N P N E P P P V V D L

GGCTACGCCCCGCTACCAAGGCTACTTGAACGAGACCGCCGGACTCTACTGGTGGCGCGGA 190
G Y A R Y Q G Y L N E T A G L Y W W R G

ATCCGCTACGCCTCGGCTCAGCGCTTCCAGGCTCCTCAGACGCCCCGCGACGCACAAGGCC 250
I R Y A S A Q R F Q A P Q T P A T H K A

GTCCGCAACGCGACTGAGTATGGACCGATCTGTTGGCCGGCTAGCGAGGGAACCAACACG 310
V R N A T E Y G P I C W P A S E G T N T

ACCAAGGGCTTGCCGCCGCCTAGCAACAGCTCGAGCAGCGCGCCGAGAAACAGGCGTCG 370
T K G L P P P S N S S S S A P Q K Q A S

GAGGATTGCCTCTTCTCAATGTCGTTGCCCCCGCCGGCTCGTGCGAGGGCGACAATCTT 430
E D C L F L N V V A P A G S C E G D N L

CCCGTCTCGTCTACATTCACGGAGGTGGCTACGCCTTCGGCGATGCGAGCACCGGCAGC 490
P V L V Y I H G G G Y A F G D A S T G S

GACTTTGCCGCCTTCACCAAGCACACGGGAACCAAGATGGTTCGTTGTAAATCTCCAGTAC 550
D F A A F T K H T G T K M V V V N L Q Y

CGTCTCGGCAGCTTTGGTTTCTCGCTGGCCAAGCCATGAAGGACTACGGTGTAAACGAAC 610
R L G S F G F L A G Q A M K D Y G V T N

GCCGGCTTGCTTGACCAGCAATTCGCCCTTCAATGGGTTCAACAGCACGTCTCGAAGTTC 670
A G L L D Q Q F A L Q W V Q Q H V S K F

GGCGGCAACCCCGATCACGTTACGATTTGGGGCGAGTCTGCAGGCGCAGGGTCCGTTATG 730
G G N P D H V T I W G E S A G A G S V M

AACCAGATCATTGCGAACGGCGGCAACACCGTCAAGGCTCTCGGTCTCAAGAAGCCCCCTC 790
N Q I I A N G G N T V K A L G L K K P L

TTCCACGCTGCCATCGGCTCCTCCGTCTTCTCCCTACCAAGCCAAGTACAACCTCCCCC 850
F H A A I G S S V F L P Y Q A K Y N S P

TTGCGCGAGCTGCTCTACTCCCAACTCGTCTCGGCGACAACTGCACCAAAGCCGCCTCG 910
F A E L L Y S Q L V S A T N C T K A A S

TCCTTCGCTTGCTCGAAGCTGTCGACGCTGCGGCGCTCGCTGCGGCGGGCGTGAAGAAC 970
S F A C L E A V D A A A L A A A G V K N

TCGGCGGCGTTCCCGTTCCGGGTTTTGGTCGTATGTCCCGGTCGTCGACGGGACCTTCTTG 1030
S A A F P F G F W S Y V P V V D G T F L

FIG. 8A

APPROVED	O.G. FIG.	
BY	CLASS	SUBCLASS
DRAFTSMAN		

ACTGAGCGCGTCGCTCCTTCTCGCCAAGGGCAAGAAGAACCTCAATGGCAACCTCTTC 1090
T E R A S L L L A K G K K N L N G N L F

ACCGGGATCAACAACCTCGACGAAGGATTCATATTCAGTACGCCACTATTCAGAACGAC 1150
T G I N N L D E G F I F T D A T I Q N D

ACGATCAGCGACCAAGTCGACGCGCTCTCCAGTTCGACCGCCTCCTCGCCGGCCTCTTC 1210
T I S D Q S Q R V S Q F D R L L A G L F

CCCTACATCACCTCGGAGGAGCGCCAGGCCGTGCGAAGCAGTACCCGATCTCCGACGCG 1270
P Y I T S E E R Q A V A K Q Y P I S D A

CCGTCAAAGGGCAACACCTTCTCTCGCATCTCGGCCGTGATCGCGGACTCGACCTTCGTC 1330
P S K G N T F S R I S A V I A D S T F V

TGCCCCGACCTACTGGACCGCCGAGGCGTTCGGCTCGTCCGCCCACAAGGGCCTCTTCGAC 1390
C P T Y W T A E A F G S S A H K G L F D

TACGCGCCGGCTCACCACGCGACCGACAACCTCGTACTACATCGGCTCCATCTGGAACGGC 1450
Y A P A H H A T D N S Y Y I G S I W N G

AAGAAGTCGGTCTCGTCCGTCCAGTCCTTCGACGGCGCGCTCGGCGGCTTCATCGAGACG 1510
K K S V S S V Q S F D G A L G G F I E T

TTCAACCCGAACAACAACGCTGCCAACAAGACCATCAACCCTTACTGGCCGACGTTTCGAC 1570
F N P N N N A A N K T I N P Y W P T F D

TCGGGCAAGCAGCTCCTCTTCAACACGACGACGAGGGACACCCTCTCTCCCGCCGACCCG 1630
S G K Q L L F N T T T R D T L S P A D P

CGCATCGTTGAGACTTCAAGCTTGACCGACTTTGGCAGGAGCCAGAAGACCAAGTGCAGC 1690
R I V E T S S L T D F G T S Q K T K C D

TTCTGGCGTGGGTCAATCTCGGTGAACGCGGGTCTC 1726
F W R G S I S V N A G L

FIG. 8B

APPROVED	C.G. FIG.	
BY	CLASS	SUBCLASS
DRAFTSMAN		

GGATCCACCCGAACCTCTGTCCCGCTTTCTGGCTTTCTTCCTTGCTGTGCCCCATCGCCT 60

|-- Translation Start -->

TTCCCGACTCGCCGCCATGCTCCTTAACCTCTTCACCCTCGCCTCCCTCGCTGCGACGCT 120
M L L N L F T L A S L A A T L

|-- Mature peptide -->

CCAGCTCGCCTTTGCCTCTCCGACCTCCCTCGTCCGCGGCACGAACCCAAACGAGCCCC 180
Q L A F A S P T S L V R R T N P N E P P

TCCCGTCGTCGACCTCGGCTACGCCCCTACCAAGGCTACTTGAACGAGACCGCCGGACT 240
P V V D L G Y A R Y Q G Y L N E T A G L

CTACTGGTGGCGCGGAATCCGCTACGCCTCGGCTCAGCGCTTCCAGGCTCCTCAGACGCC 300
Y W W R G I R Y A S A Q R F Q A P Q T P

CGCGACGCACAAGGCCGTCCGCAACGCGACTGAGTATGGACCGATCTGTTGGCCGGCTAG 360
A T H K A V R N A T E Y G P I C W P A S

CGAGGGAACCAACACGACCAAGGGCTTGCCGCGCCTAGCAACAGCTCGAGCAGCGCGCC 420
E G T N T T K G L P P P S N S S S S A P

GCAGAAACAGGCGTCGGAGGATTGCCTCTTCCTCAATGTCGTTGCCCCCGCCGGCTCGTG 480
Q K Q A S E D C L F L N V V A P A G S C

CGAGGGCGACAATCTTCCCGTCTCGTCTACATTACGGAGGTGGCTACGCCTTCGGCGA 540
E G D N L P V L V Y I H G G G Y A F G D

TGCGAGCACCGGCAGCGACTTTGCCGCCTTCACCAAGCACACGGGAACCAAGATGGTCGT 600
A S T G S D F A A F T K H T G T K M V V

TGTAAATCTCCAGTACCGTCTCGGCAGCTTTGGTTTCCTCGCTGGCCAAGCCATGAAGGA 660
V N L Q Y R L G S F G F L A G Q A M K D

[---- Intron #1 -----]

CTACGGTGTAACGAACGCCGGCTTGCTTGACCAGGTGAGTTTCCCGCATGATACCCGCCC 720
Y G V T N A G L L D Q

-----]

ACCTTTCGACTCATGCTGACGCCTCTCCCGCTCGCAGCAATTGCCCCTTCAATGGGTTCA 780
Q F A L Q W V Q

ACAGCACGTCTCGAAGTTCGGCGGCAACCCCGATCACGTTACGATTTGGGGCGAGTCTGC 840
Q H V S K F G G N P D H V T I W G E S A

[---- Intron #2 -----]

AGGCGCAGGGTCCGTTATGAACCAGATCATTGCGAACGTGAGCCACCCGAACCGATCTCC 900
G A G S V M N Q I I A N

-----]

AGCCGACTTTCcccccccccccccccccccgctgacctccctcgctttgcagggcggaaca 960
G G N T

CCGTCAAGGCTCTCGGTCTCAAGAAGCCCCTCTTCCACGCTGCCATCGGCTCCTCCGTCT 1020
V K A L G L K K P L F H A A I G S S V F

TCCTCCCCTACCAAGCCAAGTACAACCTCCCCTTCGCCGAGCTGCTCTACTCCCAACTCG 1080
L P Y Q A K Y N S P F A E L L Y S Q L V

FIG. 9A

T03000 03000

APPROVED	O.G. FIG.	
BY	CLASS	SUBCLASS
DRAFTSMAN		

CTGCGGCGCTCGCTGCGGCGGGCGTGAAGAACTCGGCGGCGTTCCCGTTCGGGTTTGGT 1200
A A L A A A G V K N S A A F P F G F W S

CGTATGTCCCGGTCTGTCGACGGGACCTTCTTGACTGAGCGCGCGTCTCCTTCTCGCCA 1260
Y V P V V D G T F L T E R A S L L L A K

[---- Intron #3 -----]
AGGGCAAGAAGAACCTCAATGGCGTGGCGAGCTTTCGAGTGCTTCAGGATCTCGCT 1320
G K K N L N G

-----] [---
GACACTGTCGACCGGCTCGCAGAACCTCTTCACCGGGATCAACAACCTCGACGAAGATGA 1380
N L F T G I N N L D E G

---- Intron #4 -----]
GTTCCCGTCTGACGGCTCTGTTTCGCCAGCGAGACTGACTTGTCTTTTGCAGAGATTACG 1440

ATTCATATTCAGTACGCCACTATTCAGAACGACACGATCAGCGACCAGTCTGCAGCGCGT 1500
F I F T D A T I Q N D T I S D Q S Q R V

CTCCAGTTCGACCGCCTCCTCGCCGGCCTCTTCCCCTACATCACCTCGGAGGAGCGCCA 1560
S Q F D R L L A G L F P Y I T S E E R Q

GGCGTCTCGCAAGCAGTACCCGATCTCCGACGCGCCGTCAAAGGGCAACACCTTCTCTCG 1620
A V A K Q Y P I S D A P S K G N T F S R

[---- Intron #5 -----]
CATCTCGGCCGTCATCGCGGACTCGACCTTTCGTGTGCGTTCCCCGTCGTCTTCTCCGAGT 1680
I S A V I A D S T F V

-----]
ATTCCGCTGACTTCCCGCTTGCCCGCAGCTGCCCGACCTACTGGACCGCCGAGGCGTTTCG 1740
C P T Y W T A E A F G

GCTCGTCCGCCCACAAGGGCCTCTTCGACTACGCGCCGGCTCACCACGCGACCGACAAC 1800
S S A H K G L F D Y A P A H H A T D N S

CGTACTACATCGGCTCCATCTGGAACGGCAAGAAGTCGGTCTCGTCCGTCCAGTCCTTTCG 1860
Y Y I G S I W N G K K S V S S V Q S F D

ACGGCGCGCTCGGCGGCTTCATCGAGACGTTCAACCCGAACAACAACGCTGCCAACAAGA 1920
G A L G G F I E T F N P N N N A A N K T

CCATCAACCCTTACTGGCCGACGTTTCGACTCGGGCAAGCAGCTCCTCTTCAACACGACGA 1980
I N P Y W P T F D S G K Q L L F N T T T

CGAGGGACACCCTCTCTCCCGCCGACCCGCGCATCGTTGAGACTTCAAGCTTGACCGACT 2040
R D T L S P A D P R I V E T S S L T D F

TTGGCAGAGCCAGAAGACCAAGTGCGACTTCTGGCGTGGGTCAATCTCGGTGAACGCGG 2100
G T S Q K T K C D F W R G S I S V N A G

GTCTCTAGGCGTCTTTCCTTCCGACTTCCTTCGTTCTTTCGTTGTTTATTCTTGCAGTTT 2160
L *

CGTTGTATCGGCCATTCGTGCGTGTAGCTCACTCGAGTATAGACGTTGGCAAGTGCGAAA 2220

FIG. 9B

03001063 030001

APPROVED	C.G. FIG.	
BY	CLASS	SUBCLASS
DRAFTSMAN		

TRN 2-1738 RHODOSPORIDIUM ESTERASE cDNA\$

Translation Start Mature Peptide
 MLLNLFTLASLAATLQLAFASPTSLVRRITNPNEPPVVDLGYARYQGYLNETAGLYWWRG
 IRYASAQRFRQAPQTPATHKAVRNATEYGPICWPASEGTNTTKGLPPPSNSSSSAPQKQAS
 EDCLFLNVVAPAGSCEGDNLPVLVYIHGGGYAFGDASTGSDFAAFTKHTGTKMVVVNLQY
 RLGSFGFLAGQAMKDYGVTNAGLLDQQFALQWVQQHVSKFGGNPDHVTIWGESAGAGSVM
 NQIIANGGNTVKALGLKKPLFHAAIGSSVFLPYQAKYNSPFAELLYSQLVSATNCTKAAS
 SFACLEAVDAAALAAAGVKNSAAFPFGFWSYVPVVDGTFILTERASLLAKGKKNLNGNLF
 TGINNLDEGFIFTDATIQNDTISDQSQRVSQFDRLLAGLFPYITSEERQAVAKQYPISDA
 PSKGNTFSRISAVIADSTFVCPTYWTAEAFGSSAHKGLFDYAPAHHATDNSYYIGSIWNG
 KKS SVSSVQSFDGALGGFIETFNPNNNAANKTINPYWPTFD SGKQLLFNTTTTRDTLSPADP
 RIVETSSLTDFGTSQKTKCDFWRGSISVNAGL*

FIG. 10

RECEIVED 1991

Amino acid composition from 1 to 572
TRN 2-1738 RHODOSPORIDIUM ESTERASE CDNA